TITLE OF INVENTION

Weapon Use Tracking and Signaling System

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BACKGROUND OF THE INVENTION

A concern, which many law enforcement, armed forces, or security personnel may encounter during a firearm confrontation, is the inability to determine with certainty when the load of ammunition in a firearm is running low in order to reload timely.

At the lack of an adequate weapon discharge reporting system that would provide crucial life preserving information to the user, currently adopted procedures in place, if any, are purely intuitive, and are acquired by training relying mostly on the user's state of mind.

At any point of a never desired but possible confrontational firing event, the inevitable strain imposed by such circumstances, ends up making it extremely difficult for the user to keep a mental record of his ammunition consumption.

Opting to replace a spent magazine is therefore turned into a hit and miss activity; a still partially loaded clip is sometimes wastefully dropped and replaced for a new one in the attempt of not being caught on empty.

It is widely known and accepted that human beings under stressful situations react more consistently when conditioned to respond to a sensorial reference than to an adopted routine that implies analytical thought and comparison into a memorized data.

Habitual conditioned reactions are for every person that drives a motor

vehicle in a city provided with traffic signals, to stop on a red light, and to go on a green one. The same applies to a flashing light form a barricade that calls for caution and a reduced speed, as a yellow traffic light would prompt said driver to prepare to stop before a change to red or prepare to advance when changing to green in a traffic signal.

Other prior art patents #5,052,138, #5,142,805, #5,592,769 and #6,094,850 disclose structures that include means to track the ammunition depletion process by closed loop monitoring the weapon's magazine or the magazine well utilizing a plurality of switches or contacts remotely wired from the tracking means hence requiring a much more complex fixed adaptation to the frame of the weapon. In the case of a residual count numerical display, the depletion process as reported could be very hard to view under certain circumstances and calls for some degree of analytical perception that could simply not be available under stress.

Patent number 6,094,850 utilizes an illuminated report at the very last portion of the load were it doesn't aid the user as a trailing signalization in the process of depletion of the ammunition load.

Patent # 5.566,486 discloses an inertial detector also with a numerical display.

Patent # 5,406,730 discloses a dual detecting means including sound and inertial event reports to the tracking means, and the display is also numerical and mounted on the grip and Patent # 6,643,968 discloses a pistol also with dual event detecting means built specifically into the frame and is aimed only for usage record keeping.

All of the abovementioned are in one or another way different and less practical to adapt to a weapon, as it will be disclosed in this application.

This application makes reference to my prior patent #5,735,070 titled Illuminated Gun Sight and Low Ammunition Warning System For Firearms

filed on 1996.

In this specification, a battery operated electronic firing event detecting, tracking and signaling system with the purpose of signaling a user about a low ammunition condition being reached was disclosed.

Among others, the possibility that this signaling means could be a visible indicator, and the possibility of utilizing multiple signal means that could be triggered at different count events was also disclosed in claims 38, 47, 51, and 52.

This application is in part a further form of the Low Ammunition Warning System portion disclosed on said application and additionally an event time and date recording assembly.

A device capable of reliably reporting the ammunition depletion process on a weapon is of evident tactical value for improving the safety of either members of the military forces or members of the police departments. In the event a confrontation may arise, they will have a simple referential indicator to help them take safe action for reloading or for better management of their critical ammunition resources.

BRIEF SUMMARY OF THE INVENTION

This invention refers to a monitoring system for firearms, including a tracking device and a method for detecting ammunition has been discharged from said weapon more specifically for a weapon usage tracking device and a method that utilizes battery operated programmable controller circuitry, and could be used in combination either with a load depletion process warning system which in turn comprises a method for signalizing the user of the depletion process, or a time and date event recorder or a combination of both sharing substantially the same structure.

When operating an automatic or semiautomatic weapon, several typical events can take place.

Asides from placing a loaded clip and removing a spent one, a trigger is pulled, the slide is displaced, an empty shell is ejected, an new round is chambered, etc.

Some of these events take place when discharging the weapon and can also be executed manually by the user. A user can pull and release the slide, can dry fire the trigger, can pull the slide and leave it open, etc.

For correctly determining what has happened with a useful degree of accuracy in order to perform a tracking operation, several provisions have to be implemented. First and foremost, there has to be in place a way of detecting an event and discriminating said event from being another.

A method utilizing an adequately certain detecting structure and a tracking structure in combination, said tracking means being a programmable controller including built in timing provision, capable of storing and running a program, which in turn includes, asides from its supporting power resource and circuitry, the corresponding logic useful for the determination of the nature of an event detected.
By determining the nature of the detected information, preprogrammed activity could then be executed with a substantial degree of certainty.

Means for ascertaining by a detecting structure adequately disposed and adapted as to report to the tracking structure positively, if a round has been discharged and reloaded automatically, if a load has been manually chambered, or furthermore, if the round just discharged was the last one of that particular load is then of fundamental importance for correctly recording real time events and reporting an ammunition depletion process.

The present invention is directed to an assembly for use on a firearm, and

more particularly, to a weapon usage detecting and tracking device adapted with the means and a method of signalization that provides the user clear visual feedback and an homologous perception of the progressive depletion of a weapon's ammunition load.

Said usage detecting and tracking structures combine also with a real time clock and memory provision to record firing events for future download.

In consideration of this not being limiting, the preferred embodiment of the present invention is compactly built into a casing that is nested on the firing pin cover plate well on a striker pin type of automatic weapon, replacing said firing pin cover in functionality also. By being in this position it becomes part of the slide structure displacing with it in its reciprocating operation. Additional secure means of affixing this assembly in place is also applied accordingly.

Visible indicators are adequately disposed in the proximal end of said casing to be visible by the user and are responsive to the tracking means to become illuminated for reporting the progressive depletion of an ammunition load.

Internally included is a power source, a simple but condensed programmable controller counter circuit in sleep mode by default, and properly disposed detecting means with optional signal conditioning supporting circuitry. Externally accessible is at least one programming and reset control button, adapted to alter presets in said programmable controller.

The detecting means is structured to report upon discharging a round, by induced dynamics or by the occurring change of position of said weapon slide portion, or by the combination of both, by deriving or generating, depending on the detecting component type in use, substantial amount of

electricity to the tracking means as to activate it from a sleep mode, said tracking means, in order to perform a tracking operation. Said tracking means consequentially is adapted to report to the user by illuminating a corresponding indicator in accordance to a preprogrammed routine.

An event recorder version includes a non-volatile memory component and a parasite digital real time clock provision adapted to the tracking structure to provide time reference so that the controller can store time and date information appended to each tracked event in chronological succession into said memory component thusly creating a data string representing the discharge history of said weapon that is retrievable at a further date.

The event detecting is resolved by means of either a switching device or by a adequate component or components capable of detecting dynamics or a combination thereof.

A switching device is utilized for establishing that the slide has abandoned the home position or has returned. Said switching device is of the normally closed type and is mounted on the assembly adequately disposed as to be urged into "off" mode whilst the slide is at the home position and said switching device detecting member is bearing in interference against a mating portion of the weapons frame. An adaptation of a film piezoelectric component that will produce a pulse on arriving to the home position could also be utilized to indicate the return of the slide to the closed position.

Upon said weapon is discharged, the slide displaces rearwards and away from said frame causing the switching device to close the circuit deriving as a consequence a sufficient amount of electricity from its power source to the tracking means as to activate it. The tracking means following its embedded instruction set utilizes its built in time tracking capabilities to identify this event.

If the circuit is broken thereafter in a time typical of the duration of a full discharge and re-chamber event, the tracking means will acknowledge such event has taken place and that there is another round in place in the chamber of said weapon.

If the switch remains conductive for more that the time it typically takes to complete a full discharge cycle including rechambering a new round of ammunition, the tracking means identifies that said discharged round was the last round of the load since semiautomatic weapons will remain by design with the slide open in such a case not allowing said switch to break the circuit.

The monitoring of the time the switching component remains enabled, still has further uses in this invention.

In this version of the preferred embodiment, if said switching component continues to remain enabled for even a longer period of time, it will invoke a second programming level accessible by the programming and reset switch of the assembly different of a first level that the user could access when the slide is collapsed and the switching detector is off.
Obviously, a user attempting to reach this second programming level, only needs to rack the weapon slide open and wait for the corresponding feedback from the indicators of the programming window being open in order to perform the desired task. Another form of this invention utilizes a supplemental switch for the same purpose instead of the switching detector.

Still further usefulness stem from the monitoring of the state of this switch by the tracking means keeping track that this detector last reported an event recognized as an empty weapon condition. Upon this happening, the count would automatically will reset to the default load count.

A possible irregular user generated circumstance, like it would be the dropping of a not fully spent clip subsequently replaced by a fully loaded one, will be corrected on a per clip basis since a per clip level of resetting will repeat itself automatically at the last round from the current load is spent, limiting cumulative error. In this case in the process of discharging the signal stack will be offset by diminishing the amount of the last warning stack on a count equal to the disposed unspent rounds, but only for one load.

This system is intended to provide means to correct conditions that result from the current lack of feedback of the depletion process of a weapon load resources, basically, the understandable practice of releasing a clip still containing some rounds in precaution of not being left with available firing power.

Abnormal use may always happen, but that is a problem of the user not being trained to be reactive to a signal system in place and that can't be predicted or resolved by any signaling or warning system. It's the main reason why traffic accidents mostly happen, but these accidents are still much less in number than if there were no traffic lights.

The luminous warning system is based on a plurality of colored indicators that become selectively illuminated every time a round is discharged starting in one particular color. As the depletion progresses, at a set point the signal changes to another color raising the alert level and will repeat, increasing the warning until the last level.

For descriptive purposes, we will describe the total number of signal pulses per color of warning level as a stack making a parallel to a stack of rounds they represent.

This system provides to the user means for being in capacity of customizing his signaling stacks to his personal preference.

Said signaling stacks are differentiated by different color indicators and report basically three levels of alert.

The alert structure is fully customizable as abovementioned, but for this disclosure, we will visualize how a basic preset could be used.

In the preferred embodiment of this invention, the total available rounds per load are divided into three stacks; each one corresponds to an alert level. A first amount, being at a level of first alert, a green light is pulsated whilst discharging this stack. Once this stack is spent, as the second alert level, a blue indicator is pulsated for each discharge of this stack. In this case a blue indicator as opposed to yellow one is used due to the fact that a yellow like color easily blends with a muzzle blast in twilight of dark. Following will be the last stack that will then be represented by a red light, which is the last and the immediate action-prompting signal.

As an example for designing a signal structure, a user having a 17 round load capacity weapon plus a chambered round that wants to implement a linearly incremental urgency warning set of signals corresponding to a progression of stacks containing counts each proportional to 3,2, and 1 could divide his load as follows:

As the total count of the load is 17+1, totaling 18, and our unit stack is one sixth of this total, deriving from the number series representing the urgency pattern of the selected signal progression as seen in 3+2+1 = 6. Then the stacks would be: 9 rounds at first warning level, 6 rounds at a second and increased warning level and 3 rounds at a third and highest warning level.

It is possible to implement other patterns by altering the counts per stack. Some users may prefer to have a longer first level and equally lasting second and third alerts, but whichever the case of personal preference is, a last stack could be referenced and linked to the sound of the discharge of three rounds in this case, and engraved into our reaction in the same way we perceive our speed and automatically adjust to brake just in time to not to transgress an intersection.

A double certain method of verification that a shot was actually discharged is also disclosed including a piezoelectric detector as part of the detecting structure.
Said piezoelectric component is disposed as to detect dynamic events substantially on a particular direction or axis. Said axis being in line with the axis of the trajectory of the ammunition discharged, said detector then reports changes of state happening substantially on said axis.

Upon discharging of said weapon, a momentary pulse is generated by this component. Depending on the type of piezoelectric component, provisions are included as needed to convert and amplify said pulse that may be an electrical charge, into a voltage pulse, turning this pulse into a signal representing an event. Supplemental provisions can be included as to further condition said signal. Said signal conditioning, according to the piezoelectric component utilized, may include band pass filters and attenuation of the natural frequency response of said detector as it is common practice in the utilization of these type of components and are based mostly on simple arrangements of resistors, capacitors and operational amplifiers. The choice substantially depends on the particular detector's electrical characteristics and sensitivity.

By having said generated electrical signal adequately treated this way, the detector's response then is optimized to detect events within a narrow low

frequency band and also can have a high threshold of rejection for non-firing events such that only high intensity directional events are detected.

As a result, when a round is discharged, a pulse that originated by the piezoelectric component upon detecting the abrupt motion and furthermore an abrupt change of state produced by said discharge activity sequence is then directed to the tracking means.

Said tracking means, receives this report and if received in combination with the switching detector reporting slide displacement, it ascertains that definitely a shot was fired in conclusion of receiving both signals in substantial succession to one each other within a known time window.

Another form of use for the adequately conditioned and tuned signal of a piezoelectric detector stems form the clearly independent spikes resulting from the set of events happening on said weapon that can be produced by said detector.

By this means, said detector signal being conditioned with sufficient amount of attenuation of its natural resonance, will distinctly detect a closely spaced sequence of events by generating a close sequence of electrical spike pulses. This typical sequence of pulses that is generated during a known amount of time will then characterize each event.

As an example, providing the weapon in question is capable of discharging in automatic mode, a total of 1200 rounds per minute. We will know as a result that a complete automatic cycle of discharge and reload independent of the human factor, will take in said weapon approximately $1/20^{th}$ of a second or 50 milliseconds.

This will signify that during a 50millisecond window of time, the properly disposed and adapted detector has reported a sequence containing three distinct spikes of substantially approximate intensity. A first pulse is generated when the actual discharging of the round takes place, a second one, when the slide reaches the limit of its outward displacement and inverts is direction, and a third one, when the slide arrives slamming into its home position. If the round fired was the last one of the load, then there will be two pulses, discharging and reaching the rearward displacement limit only, since the weapon will remain in open position. If it is manually reloaded and allowed to slam the home position, it will detect a chambering of a first round and determines this as being true by a logic operator in the program in the controller that refers back to the last know reported event as said weapon being emptied and left open.

A more simplified version of this assembly obviates the double detector structure in favor of this single tuned piezoelectric detecting means approach, mediating reliable control to successfully marry the consistency of the selected piezoelectric detector performance with its supporting electronics and the encasement in which it will be housed. A detector adapted in this way can act like a pickup "seeing" other mechanical activity like the firing pin colliding internally against the rear wall of the firing chamber whilst dry firing it, which in turn could be if desired, by design, utilized as a training advantage.

A corrective reset to default switch provided comes into play when the weapon has being utilized and handled in a different ways than intended, introducing error to the tracking means. This switch is provided to bring again the system ready to start tracking from the beginning of its preset.

New developments in other type of sensors provide the opportunity of utilizing other properties of the events happening upon the discharge of a round.

In a handgun, a substantial portion of the firing energy is translated into angular motion.

At the moment of discharge, as a result of the recoil generated, the fired weapon abruptly tilts backwards, synchronized with the rearwards displacement of the slide portion of said weapon.

Upon reaching the rear limit of the stroke, the motion is inverted and said slide portion returns to its home position whilst drawing a new round into the chamber, displacing its mass forwardly finally slamming against its limit forward position. In this process the angular displacement is reversed and an amount of forward tilt beyond the original aiming position takes place.

By detecting this angular motion with a properly disposed rotational sensor, a firing of a weapon can be also identified.

Expanding further into other option of the present embodiment, the detecting and the tracking means being adapted to report and positively identify a discharge event has certainly happened, serve also to prompt to record into memory provision these events in combination to a referential timetable provided by an appended real time clock and said memory provision. The clock device is of a new type of package, which includes an extremely small, built in crystal providing the functionality and the shock resistance in an extremely small footprint.
Communication means are provided on the assembly as to allow access with a properly adapted external means to the data stored on said memory provision. The memory provision is adapted to record events in a successive

manner such that when its storage capacity is reached, it will handle the next data input by overflowing and eliminating the oldest events previously stored. The memory component of choice in this embodiment is of the I^2C serial type device. This allows operation with a minimal amount of connectivity and its streamlined protocol is sufficiently fast for this application.

Management of the recording operation as well as a secure handshake routine for enabling weapon usage data download to said external device is also implemented to be performed by said tracking means upon being enabled and as queried by an external interface adapted for the purpose.

Due to the fact that installations like this one, where the space is at its premium, it only makes common sense to utilize a means of accessing the memory chip in a way in which the interconnecting means has also minimum space requirements. A currently available technology for chip-to-chip communications is the I^2C serial bus protocol that requires only three conductors one of which is ground. The others are the talking wires. Compliant to the nature of this kind of serial communications, on the preferred embodiment, an interface connected to the provided pads on the circuit board of the assembly will then contains a device acting as the master chip, and the memory chip will then act as the slave chip. With this into consideration, and furthermore considering that the data to be downloaded has to be an exact copy of the contents of said memory chip, and considering even furthermore that said memory chip contents should not be altered, the interface is built with no user capacity to act upon the data in view of the abovementioned considerations. This is done by embedding an adequately keyed routine into the interface controller chip. Following the data path, there is a computer provision with a screen including also secure software means that automatically encrypts upon downloading, the downloaded information into a integral file that can be viewed and can be printed but can't be altered containing the serial number and the use history of the unit queried.

User and weapon specific parameters, like total load count, establishing at what remainder number of rounds a luminous signal change will occur, a first load extra count in case the user prefer to carry a first shot chambered like most police officers do, a preview or demonstration mode to verify the count and the signal pattern or a reset to default, are all easily keyed in among others, by the user straight into the device via the program and reset switch without any supplementary equipment or accessory. Further implementations are also possible and quite simple to accommodate, like providing a point of access for an external switch that in turn can be adapted in a structure that slip temporarily over the trigger, making it possible to train without live ammunition.

It is a primary object of this invention to provide to the user of a weapon with an assembly adapted to said weapon capable of reporting ammunition discharge by the use of luminous indicators and a signaling method to be used in the same that will provide the means for a user to receive trailing feedback of his ammunition expenditure offering said user the opportunity to become conditioned to react and act safely in view of a luminous signal or signal change whilst using said weapon, in no different way that an automobile driver becomes conditioned to react to a luminous warning signal whilst driving in a city with luminous traffic signals in which a particular light color has an established significance in aiding said driver to make safe decisions accordingly.

It is an object of this invention to provide a reliable method to detect, track and identify events happening in the operation of a weapon such that it serves as the supporting functional structure for an ammunition depletion warning system or a discharge monitoring and recording device, or the combination of both.

It is a further object of this invention to provide the advantages described in

this application, on a low cost compact assembly that lends itself to be embedded or easily adapted to a weapon, or encased so that it can interchangeably replace an original component of said weapon, providing to the user with the benefits of this system in addition of it fulfilling at least the function of the component it replaced.

It is still a further object of this invention to provide a weapon discharging monitoring system that will enable time and date related usage to be recorded in a memory provision in correlation with the actual time and date data supplied by a real time clock, including means to download said records at a further date.

It is a further object of this invention to provide a secure form of affixing said monitoring assembly.

It is still a further object of this invention to provide secure means to download data from a weapon utilizing the I^2C bus protocol.

It is a further object of this invention to generate as the result of the downloading data from a weapon, a secure digital document that will represent accurately the use history of a particular weapon.

BRIEF DESCRIPTION OF THE DRAWINGS

As a reference to aid in the understanding of the present invention the following drawings are provided in which:

Fig. 1 is a simplified lateral view of a semiautomatic handgun in which the preferred embodiment is mounted.

Fig. 2 is a rear three-dimensional view of the capsule containing the assembly.

Fig 2a is an angular rear view in which a firing ping cover plate and the system assembly are compared.

Fig 3 is a rear view of the system's preferred assembly showing a switching slide position detector.

Fig. 3a is a rear view of the system's preferred assembly showing a piezoelectric film slide position detector.

Fig. 4 is a depiction of the system's preferred assembly being installed in the firing pin cover plate well.

Fig. 5 is a cut close up view of the mounted assembly showing more detail.

Fig. 6 is a simplified cut out view of a weapon with the system mounted showing more detail including the area of engagement of the slide position detector.

Fig. 7 is a simplified cut out view of a weapon containing this system at rest but in the instant the firing pin strikes a live round of ammunition.

Fig. 8 is a simplified cut out view of the same weapon at the moment it has reached the limit of its rearward displacement as it tilts backwards as a consequence of the typical recoil.

Fig. 9 is a simplified cut out view of the same weapon as it undergoes some amount of forward tilting typically induced by the slide returning to the home position with a new round as it slams into the limit stop.

Fig. 10 is a frontal isometric exploded view of the monitoring device.

Fig. 11 is a rear isometric view of the same.

Fig. 12 is a diagram representing in succinct mode the concept of how the functional components fit in the system circuit.

Fig. 13 includes is an explanatory view of the procedure of connecting into the monitoring device for downloading data.

Fig. 14 is a diagram representing in succinct mode on the concept of how the functional components fit in the circuit of the data download interface.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the several views of the drawings; initially is viewed on:

Fig. 1 is a simplified representation of the preferred embodiment of this invention installed in the rear of portion of the sliding carriage of a handgun, attached and held in place by an anchoring portion of its structure being nested and held in place by spring force in replacement of the firing pin cover plate.

On the weapon depicted, there is a frame 1, and a barrel 3 nested on a sliding structure 2 in the rear of which the monitoring assembly 4 is installed.

The assembly has a recessed area 5 where the luminous indicators are located disposed to emit light in the direction of the user. There is a readily available program and reset button 6 that is adapted to reset the count to the count loop default at any point of use.

This button is used mostly for resetting to the default count the system every time needed but also serves to alter the presets on the embedded program.

As a reference, by pressing and holding this button 6 for a first amount of time, a first level of programming becomes available to the user. When doing so, the device responds by reporting to the user by means of a special luminous pattern informing that certain parameter can be altered with the

same switch like i.e. "adding to the total load count". By pulsing said button 5 consecutive times, 5 rounds have been added to the total count. When done with this process, by leaving it at rest for a duration and then pressing momentarily once more to return to default, another "press and hold" routine can be applied for a longer duration, the device then reports a different luminous pattern displayed and the controller opens another window of programmability which could be "subtract from the total load" and so forth. By utilizing this method and in combination with a second switch, a state change is invoked on the first switch, doubling the windows of opportunities for altering the presets.

Fig. 2 is the monitoring assembly in which a cover portion 8 is indicated, a metallic housing 7 covers and protects the electronic circuitry, a luminous indicators window 9 and a program and reset switch are shown.

Fig. 2a depicts the monitoring assembly and the firing pin cover plate. Further demonstrates details 11 and 15 as being similar between the monitoring assembly and the firing pin cover plate as to provide similar engagement when installed in place.
Similarly, 12 and 14 indicates equivalent retention features as to nest the spring-loaded rear housing of the firing pin assembly when in place. Almost hidden but still visible in this view is the switching detector detecting arm13.

Fig. 3 is an orthogonal view of the back portion of the switching version of the monitoring assembly where 16 is the switch arm.

Fig. 3a is an orthogonal view of the same device but the switching device has been replaced by a piezoelectric film component that is adapted to deflect on contact with the frame generating a pulse of electricity upon returning to the home position.

Fig. 4 shows the removal from a weapon slide of a standard firing pin plate cover 18 from its location 19 and replacing it with the monitoring assembly 20. This drawing also shows securing component 22 and metal pin 21.
Further it shows the same weapon slide with the monitoring assembly already installed and secured with 22 in place and 21 installed in provision 24.

Fig. 5 is a close-up view of the installation showing a version that includes a double button 30 and 28 for programming when the detecting means doesn't include a switching slide position detector. 6 is the weapon slide, 27 is the secure assembly and 29 shows the luminous indicator window.

Fig. 6 is a simplified cross section of the weapon slide 32 and the monitoring and signaling device as attached in the firing pin cover plate well. 33 shows the engagement portion of the assembly as it resides nested in the slot provided for said cover plate, 34 shows the axial end of a retaining pin inserted to hold in place the securing component 22 in fig 4. 35 is the portion of the housing that encapsulates the electronic components. 36 is the program and reset switch. 37, 38 and 39 are the luminous indicators aimed on the direction of the user. The type used in this assembly are of a special highly efficient ultra bright family of dies packaged on a clear dome lens medium size surface mount device. The choice of these lamps is of crucial importance for obtaining a strong signal easily viewable at daylight and a long battery life.
40 is a cross sectional representation of what the home position of the slide position detector would be and 41 is the portion of the frame that bears in close contact against said detector detecting means.

In fig. 7, 8 and 9 depict summarily the recoil activity as a result from discharging a round.
In fig.7 is the depiction of the weapon at rest in the instant it is going to be

discharged where 42 is the point of contact between the monitoring device and the frame.

Fig. 8 represents the end of the rearward motion of the slide of the weapon including the rearward tilt typically induced by this event and the distance between 43 which is the mating part of the frame where the position detector makes contact at the rest position, and the detector 44.

Fig. 9 is the weapon at the point it has just slammed shut in its return to the home position with a new round in the chamber. The typical momentary forward tilt is also shown. 45 is the detector now back in contact with the frame.

Fig. 10 is a frontal exploded view of the actual total assembly of the monitoring device where 47 is the metal housing which is manufactured from a section of a custom designed aluminum extrusion that has been cut to size and machined to further configure the features required and has also been heat treated for stiffness and furthermore anodized for corrosion resistance.

There is a double side multilayer pc board 50 containing all the required surface mount components in a dense arrangement. To optimize the space distribution, an exact three dimensional model of each of the components required was constructed including the solder pads and following the layout restrictions, the space was optimally distributed. Due to the density of the resulting circuit, all signal routing is mostly done in buried layers accessing these from underneath the footprint of the components.

60 represent two lithium 1025 coin cells installed in series providing 6 volts of electricity to the circuit. 51 is the programmable controller that is the PIC16F630. This is a CMOS Flash-based 8-bit microcontroller in an extremely compact 14-pin TSSOP package. This device includes 1 comparator and 128 bytes of EEPROM data memory and 1024 words of program memory capacity, all of which in combination serve as a substantially sufficient platform for this application. 52 is the rear projection of the switching detector, 53 is an extremely low profile tactile switch to be

actuated by plunger 49 and button 46 in combination. 54 is one of the surface mount ultra bright high efficiency LED luminous indicators and 48 is a cover lens intended to provide seal and protection and which may or may not provide a degree of diffusion in accordance to the visual report desired.
55 is a legless extremely compact clock device that contains a crystal integral to the same package resulting in a complete real time clock assembly for providing the real time base information to the controller so that the discharge events are correlated to real date and time. 56 is a I^2C compliant eeprom device that receives and retains the information of the time and date the weapon being monitored was discharged. 57, 58 and 59 are representative of supporting components for the controller and the signal conditioning circuitry. 61 is a plastic injection molded structure that includes the details required to contain the assembly further fitting into the metal housing. 62 is a sealing gasket component aimed also to provide electrical isolation to the assembly and 63 is a structural metallic component that will act as a lid and as a mating member when in place and in contact with the weapon's firing pin.

Fig. 11 is a rear view of the exploded assembly in which 64 is the switch arm of switching detector 52, 65 are three pads in place for accessing the memory provision.
66 is a surface mount piezoelectric device which is represented here as one possibility of detecting dynamics utilized in this preferred embodiment but this could be replaced by a cantilevered bimorphic ceramic component or a piezoelectric film inertial flapper or a rotational sensor and the corresponding supporting electronics represented among 67, 68, 57, 58, 59 and others depicted and not numbered would be adequately replaced.

In Fig. 12 is not a circuit schematic but a basically objective diagram. In here, 76 is the controller to which the indicator lamps 81,82 and 83 are attached. 79 is the control means which is actually the program and reset switch. 78 is

the switching detector, which is also a control means for invoking a second level of programming use in 79. In the case of the version of the system that utilizes a single piezoelectric detector, 78 is installed as 79 in immediate access to the user and becomes a device of control only. 77 is the main dynamics detector and 80 is the signal conditioning circuitry interfaced between the output yielded by 77 and the controller 76. 84 is the real time clock device, which includes a crystal, and 85 is the I^2C compliant eeprom device. 86 is the point of access for retrieving the data stored in 85.

Fig. 13 is a view that shows the monitoring device 69 indicating the location of access port for data download 72. The download plug 70 shows tip 71 aimed to contact the download pads 73 of assembly 74. 75 depict the plug output to the download interface. For clearer viewing, this is shown as displayed, but this operation can be performed as the unit is mounted onto a weapon.

Fig. 14 is a diagrammatic representation of a typical interface that can be used to access the data stored on the eeprom utilizing its provided I^2C serial interface capability. 87 relates to the download plug as also seen on fig 13, numbers 70, 71 and 75. 88 is the microcontroller PIC16F630 in charge of carrying on the querying, the handshake and security protocols of the monitoring system, and 89 is a MAX232 driver/receiver that is a low power interface translator for further communicating with a personal computer via a DB9M serial connection. The computer attached will be running special encryption software for the purpose of downloading the contents of the memory storage and the serial number of the device in a way that its output is a read-only file in order to prevent tampering with the reported data.